Answer on Question #77351, Physics / Electromagnetism

Question. The force on a charged proton (charge $1.6 \cdot 10^{-19} C$) travelling at $3 \cdot 10^6\, m/s$ through a magnetic field of $4\, T$ is:

Solution.

According to the Lorentz force

$$\vec{F} = q\vec{E} + q[\vec{v}, \vec{B}]$$

So, $\vec{E} = 0$. We get

$$F = qvB \cdot \sin\alpha$$

If $\alpha = 90°\ then\ \sin 90° = 1$. Thus

$$F = qvB \cdot \sin\alpha = 1.6 \cdot 10^{-19} \cdot 3 \cdot 10^6 \cdot 4 \cdot 1 = 19.2 \cdot 10^{-13}\, N$$

If $\alpha = 0°\ then\ \sin 0° = 0$. Thus

$$F = 0$$

If $0 < \alpha < 90°$ then

$$F = qvB \cdot \sin\alpha = 1.6 \cdot 10^{-19} \cdot 3 \cdot 10^6 \cdot 4 \cdot \sin\alpha = 19.2 \cdot 10^{-13} \cdot \sin\alpha\, , N$$

Answer. $F = 19.2 \cdot 10^{-13} \cdot \sin\alpha\, , N$. If $\alpha = 0°$, $F = 0$; if $\alpha = 90°$, $F = 19.2 \cdot 10^{-13}\, N$.